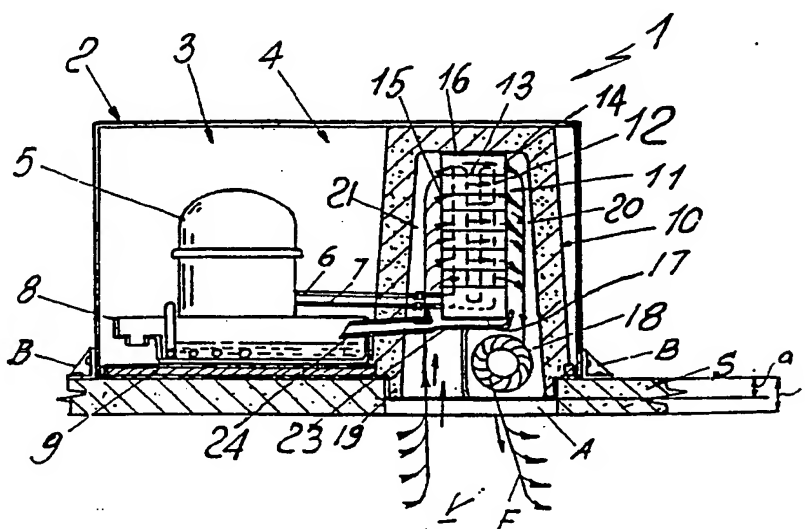




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(54) Title: MONOLITHIC REFRIGERATION UNIT FOR REFRIGERATION CHAMBERS AND THE LIKE



## (57) Abstract

A refrigeration unit (1, 1') for refrigeration chambers and the like, particularly for external roof- or wall-mounting, comprises an evaporator (4) and a compressor (3) which are arranged inside a cabinet. The evaporator comprises a coil which is embedded in a finned pack (13) which is substantially shaped like a narrow parallelepiped with a pair of open main faces (14, 15), which define inlet and outlet sections for the air to be cooled, and at least one pair of closed smaller faces (16, 17), and also comprises a centrifugal fan (18) which is arranged laterally to the finned pack in a position which is adjacent to one of its closed smaller faces so as to generate a flow which is parallel to its inlet and outlet sections, reducing the front bulk of the evaporator.

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MONOLITHIC REFRIGERATION UNIT FOR REFRIGERATION CHAMBERS AND  
THE LIKE

The present invention relates to a monolithic refrigeration  
5 unit for refrigeration chambers and the like, particularly  
for external roof- or wall-mounting.

Modern refrigeration units essentially comprise an evaporator  
with a coil constituted by a copper pipe in which a  
10 refrigerating fluid, generally constituted by a gas with a  
low liquefaction point, circulates. The pipe is connected in  
series to a compressor and to an expansion valve or to a  
capillary tube. The coil is embedded in a finned pack which  
is normally shaped like a narrow parallelepiped with larger  
15 outer faces which respectively define the inlet section and  
the outlet section for the air to be refrigerated. The  
evaporator is furthermore provided with an electric fan which  
has the purpose of conveying through the finned pack the air  
drawn from the internal compartment of the chamber, which  
20 transfers the evaporation heat to the refrigerating fluid.

In known refrigeration unit models, the fan is of the axial  
type with the impeller arranged in front of the coil, i.e.  
with its axis at right angles to the inlet and outlet  
25 sections of the finned pack, so that the flow passes through  
the pack in a direction which is perpendicular to said  
sections.

A consequence of this arrangement is that the transverse  
30 dimensions of the evaporator are at least equal to those of

the front section of the coil and are proportional to the outer diameter of the impeller of the fan. Furthermore, since the axial dimensions of the motor and of the impeller of the fan cannot be reduced to less than certain values, the evaporator as a whole has a considerable size also in a direction parallel to the flow, and in many cases protrudes from the front wall of the cabinet-like container of the monolithic unit. Thus, while the monolithic unit with the compressor assembly is fixed on the outside of the chamber, the outlet of the evaporator, which is inserted in a corresponding opening defined in the roof or in a lateral wall of the chamber, can protrude partially into the internal compartment of said chamber, with the consequence of significantly reducing the useful storage space.

The aim of the present invention is to eliminate the above problem by providing a monolithic refrigeration unit for refrigeration chambers and the like, particularly for external roof- or wall-mounting, which is more compact and smaller than those of the past, and also does not protrude at all into the chamber.

This aim and other objects which will become apparent hereinafter are achieved by a monolithic unit of the above described type, having the characteristics defined in the accompanying claim 1.

Advantageously, the evaporator assembly comprises a coil with finned pack which is shaped like a narrow parallelepiped and a centrifugal fan which is adjacent to a narrow side edge of

the finned pack and is adapted to generate a flow of air which is substantially parallel to the inlet and outlet sections of the finned pack so as to reduce the front bulk of the evaporator and of the entire cabinet-like frame.

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A monolithic unit having the claimed characteristics has extremely small transverse and front dimensions and can be fixed both to the roof of the refrigeration chamber and to an outer lateral wall thereof without protruding at all into the internal compartment of the chamber.

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Further characteristics and advantages will become apparent from the following description of two preferred but not exclusive embodiments of a monolithic unit according to the invention, illustrated only by way of non-limitative example in the accompanying drawings, wherein:

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Figure 1 is a general perspective view of a first embodiment of the unit according to the invention, in particular of the roof-mounted type, raised with respect to the upper wall of a refrigeration chamber;

20

Figure 2 is a vertical sectional side view of the refrigeration unit of Figure 1 in operating position;

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Figure 3 is a general perspective view of a second embodiment of a refrigeration unit according to the invention, in particular of the wall-mounted type, separated from the side wall of a refrigeration chamber;

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Figure 4 is a sectional side view of the refrigeration unit of Figure 3 in operating conditions.

- Figures 1 and 2 illustrate a roof-mounted refrigeration unit, generally designated by the reference numeral 1; the refrigeration unit comprises an external cabinet-like frame 2, normally made of metal plates, with a substantially rectangular vertical and horizontal cross-section.
- 10 A compressor assembly, generally designated by the reference numeral 3, and an evaporator assembly, designated by the reference numeral 4, are arranged within the cabinet-like frame 2.
- 15 The compressor assembly 3, of a per se known type, comprises a positive-displacement compressor 5 which is connected to the evaporator 4 by means of feed and return pipes 6 and 7 and is fixed to the closing wall 9 of the cabinet-like frame 2 with a condensate drainage tray 8 interposed.
- 20 The evaporator assembly 4 is enclosed within a separate container 10 which generally has the shape of an inverted tray. Container 10 is made of thermally insulating material, for example polyurethane foam, and is arranged adjacent to the compressor assembly and is also fixed to the lower wall 9 of the cabinet 2.
- 25

The evaporator 4 is essentially constituted by an exchanger, generally designated by the reference numeral 11, which is formed by a coil 12, made of copper or of another equivalent

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material. Coil 12 is connected to the compressor 5 by means of the pipes 6 and 7 and is embedded in a finned pack 13 which is preferably shaped like a thin parallelepiped, with a pair of main faces 14 and 15 and at least one pair of lateral 5 faces 16 and 17 which are narrower than the main ones. The main faces 14 and 15 are open so as to define the inlet and outlet sections for the air, whereas the smaller lateral faces 16 and 17 are closed so as to guide the flow through the coil.

10

According to the invention, an electric fan 18 is arranged ahead of the exchanger 11 in a position which is adjacent to the smaller side 17 and proximate to the open edge 19 of the container 10, which defines the inlet and outlet of the 15 evaporator with respect to the compartment V of the refrigeration chamber. In particular, the fan is of the centrifugal type, with an appropriately provided impeller and with redirection vanes which generate a flow which is at right angles to the axis of the impeller and whose exit 20 direction is approximately parallel to the entry direction. More precisely, it is noted that the direction F of the flow leaving the impeller can be slightly inclined with respect to the intake direction by an angle comprised between  $5^{\circ}$  and  $40^{\circ}$ .

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Advantageously, the finned pack 13 is chosen so that it is slightly narrower than the width of the container 10 and is fixed in an approximately central position, so that its lateral main faces 14 and 15 are substantially equidistant 30 from the inner surfaces of the container 10, so as to form

passages or channels 20, 21. Thus, the air drawn by the fan 18 can flow through the pack, forming, ahead and after said pack and along the passages 20 and 21, flows whose direction is substantially parallel to the output sections 14 and 15 and perpendicular to the direction of the vanes of said pack, contrary to what occurs in the known art. This condition, combined with the relative position of the fan 18 with respect to the exchanger 11, produces a considerable reduction in the main cross-section of the evaporator with respect to those of the prior art.

Conveniently, the port 19 defined by the open edge is provided with a redirection baffle 22 to prevent the mixing of the input flow with the output flow.

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The edge 19 of the container 10 furthermore protrudes from the closing wall 9 of the cabinet-like frame 2 by a length a which is less than the thickness s of the roof of the refrigeration chamber, so that it can be inserted in a corresponding opening A formed in the roof S of the refrigeration chamber, remaining inside said roof without limiting the useful space within the chamber. It is noted that in this embodiment the compressor assembly and the evaporator assembly are fixed adjacent to the closure wall 9 which is constituted by a base plate which is anchored to the roof S by means of brackets B.

A collection tray 23 is arranged below the coil 11 and is connected by means of a duct 24 to the main drainage tray 8. Furthermore, openings 27 with grilles for the ventilation of



the compressor assembly 3 are defined on the side walls 25 and 26 of the cabinet-like frame 2. Finally, adjustment and control devices 29 may be arranged on a side wall 28 of the cabinet 2.

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In a refrigeration unit of the above described type, the outer cabinet 2 can have outside dimensions of approximately 570 mm x 480 mm x 300 mm, with a rectangular port 14 measuring approximately 450 mm x 250 mm.

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The wall-mounted refrigeration unit model, illustrated in Figures 3 and 4, is designated, generally and in its components, by the same reference numerals with primes added. This model is practically identical to the preceding one, with the only difference that the evaporator assembly 4' is superimposed on, instead of adjacent to, the compressor assembly 3'. In this case, the two assemblies are rested on, and fixed to, a closure plate 9 which is perfectly identical to the lower one of the roof-mounted model 1, which is meant to make contact with, and be fixed to, an outer wall P of a refrigeration chamber by means of brackets B'.

The monolithic refrigeration unit according to the invention, both in the roof-mounted model and in the wall-mounted model, achieves the intended aim, and in particular is more compact than the similar devices of the known art, and also does not protrude into the inner compartment of the chamber, optimizing the storage space thereof and simplifying all the operations for the assembly and maintenance of the unit.

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Although the invention has been described with reference to the embodiments illustrated in the drawings, it is understood that the refrigeration unit is susceptible to numerous modifications and variations, all of which are within the  
5 scope of the inventive concept expressed by the accompanying claims.

CLAIMS

1. Refrigeration unit (1; 1') for refrigeration chambers and the like, particularly for external roof- or wall-mounting, comprising a compressor (3; 3') connected in series to an evaporator (4; 4'), said evaporator being constituted by an exchanger (11; 11') formed by a coil (12; 12'), said coil being embedded in a finned pack (13; 13') which is substantially shaped like a narrow parallelepiped with a pair of open front faces (14, 15; 14', 15'), said faces being substantially perpendicular to the fins and defining inlet and outlet sections for the air to be cooled, said parallelepiped having at least one pair of closed transverse faces (16, 17; 16', 17') which are narrower than said front faces, and being also constituted by an electric fan (18; 18') for conveying the air to be cooled against said exchanger (11; 11'), characterized in that said electric fan (18; 18') is of the centrifugal type and is arranged laterally to said finned pack (13; 13') in a position which is adjacent to one of said closed transverse faces (16; 17) so as to generate a flow which is substantially parallel to said inlet and outlet sections (14, 15; 14', 15'), so as to reduce the front bulk of the evaporator.

2. Monolithic unit according to claim 1, characterized in that said exchanger (11; 11') and said fan (18; 18') are arranged inside a tray-like container (10; 10') with an open edge (19; 19') which forms a port for the connection of said evaporator to the inner compartment (V) of the refrigeration chamber or the like.

3. Monolithic unit according to claims 1 and 2, characterized in that said finned pack (13; 13') is narrower than the width of said container (10; 10') and is arranged inside it so that its inlet and outlet sections (14, 15; 14' 15') are slightly spaced from the inner surfaces of said container (10; 10'), defining longitudinal passages (20, 21; 20', 21') which are substantially perpendicular to the fins of said pack (13; 13') and are parallel to the inlet and outlet sections thereof.

10

4. Monolithic unit according to the preceding claims, characterized in that said evaporator assembly (4, 4') and said compressor assembly (3; 3') are entirely enclosed within a cabinet-like frame (2, 2') with a lateral or lower closure plate (9; 9') which can be anchored to the refrigeration chamber substantially at an external upper wall (S) or side wall (P) thereof.

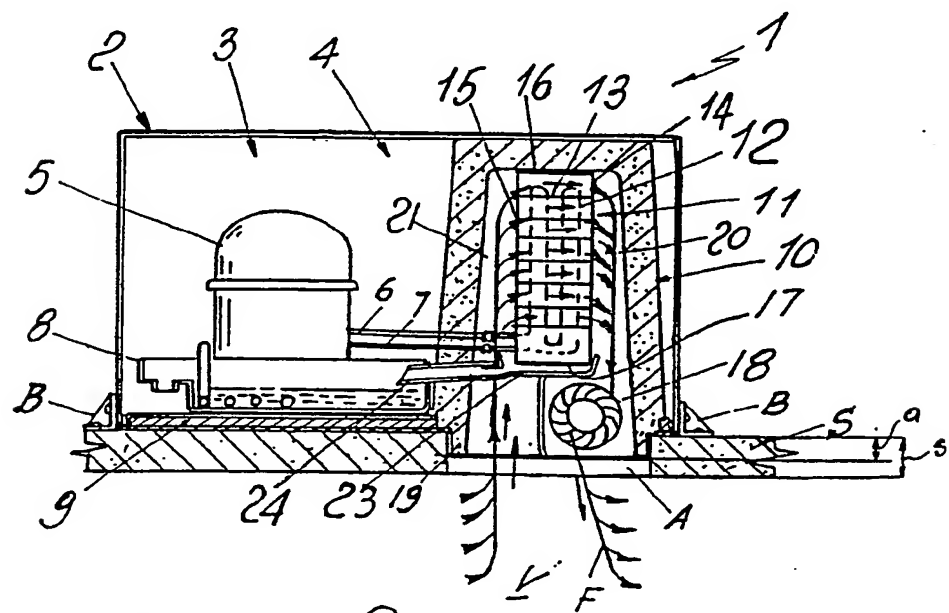
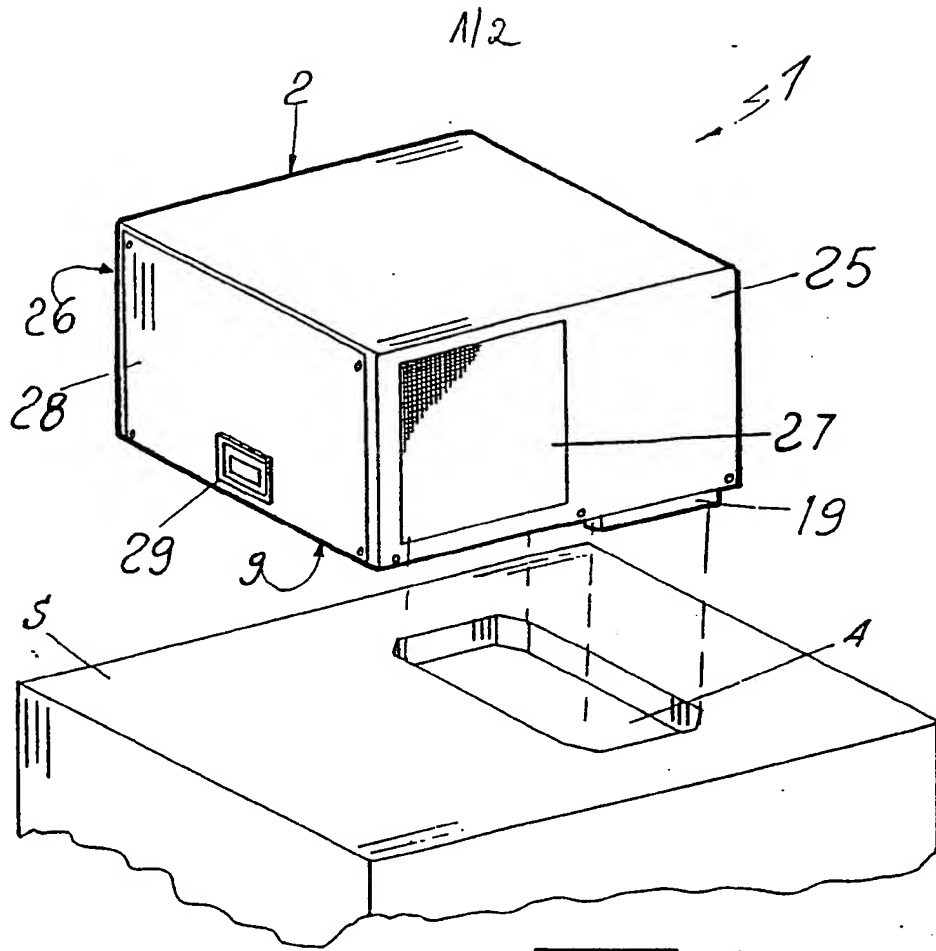
5. Monolithic unit according to the preceding claims, characterized in that said connecting port (19; 19') of said evaporator (4; 4') protrudes from said closure plate (9; 9') of said cabinet-like frame (2; 2') by an extent (a) which is less than the thickness (a) of the wall (S, P) of the chamber so that it does not protrude into the inner compartment (V) thereof.

6. Monolithic unit according to one or more of the preceding claims, characterized in that the output flow (F) of said centrifugal fan (18; 18') is approximately parallel to the input flow.

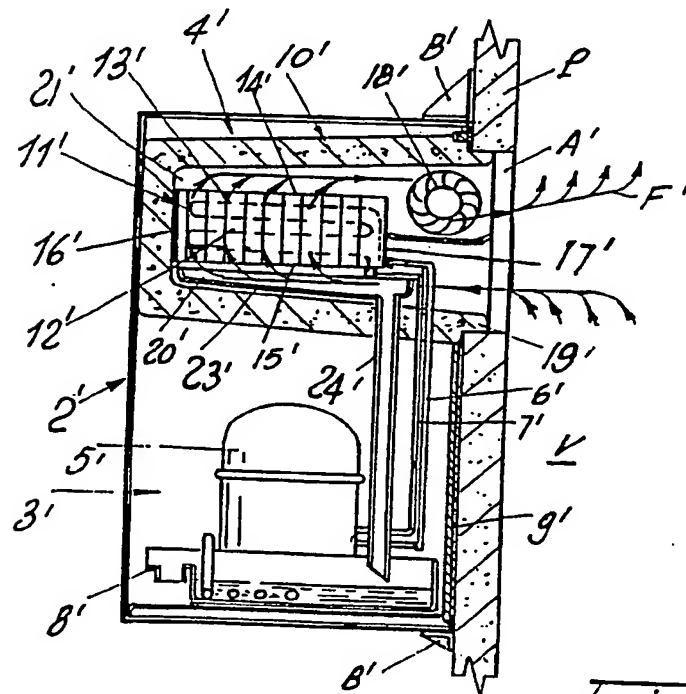
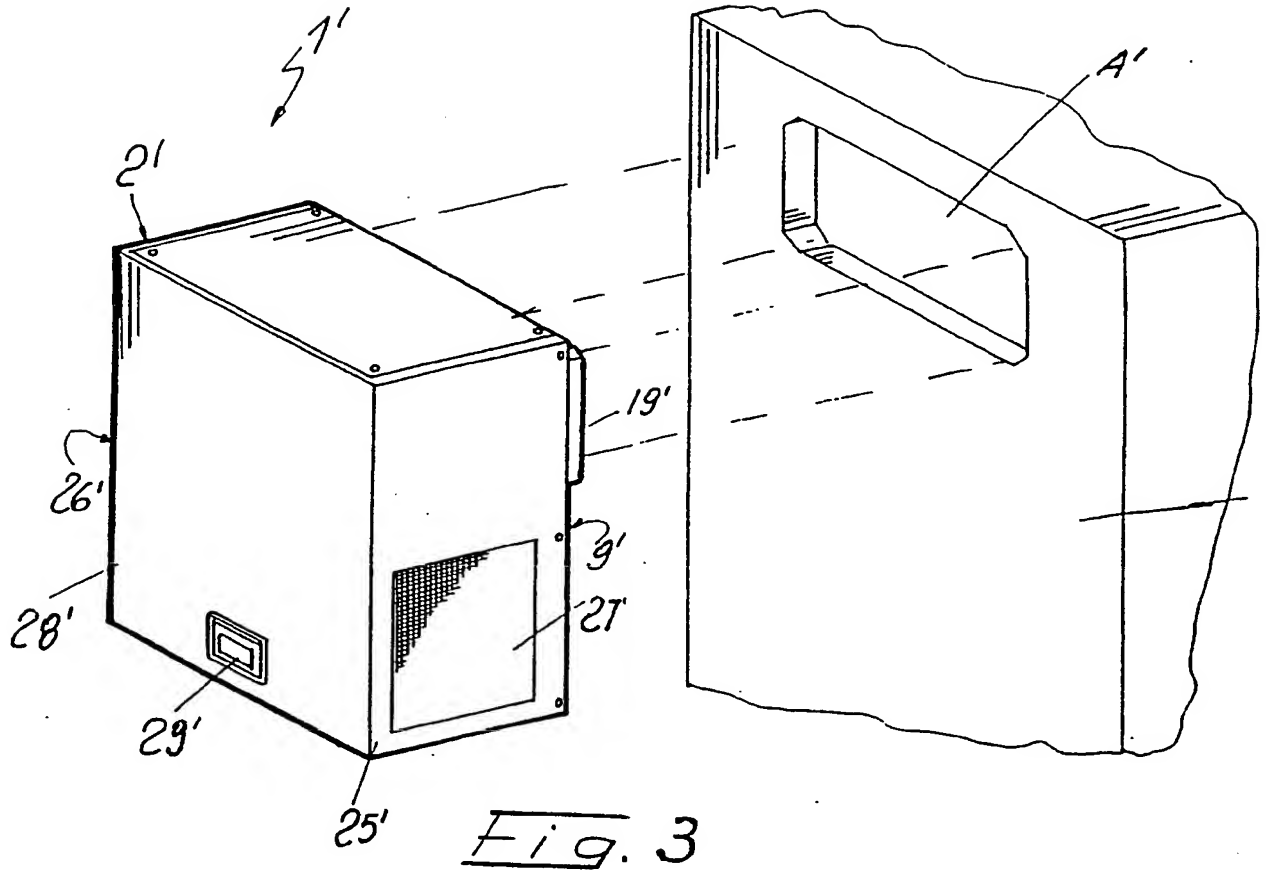
7. Monolithic unit according to claims 1 to 7, characterized in that said compressor assembly (3) and said evaporator assembly (4) are arranged side by side and are fixed on said closure plate (9) of the cabinet-like frame (2) which is provided with said connecting port (19), said port being insertable in a corresponding cavity (A) defined on the roof (S) of a refrigeration chamber or the like.

8. Monolithic unit according to claims 1 to 7, characterized in that said compressor assembly (3') and said evaporator assembly (4') are mutually superimposed and fixed laterally to said closure plate (9') of the cabinet-like frame (2') which is provided with said connecting port (19'), said port being insertable in a corresponding cavity (A') defined on a side wall (P) of a refrigeration chamber or the like.

9. Monolithic unit according to the preceding claims, characterized in that it has a redirection baffle (22; 22') for separating the input flow from the flow which exits from said connecting port (19; 19') of said evaporator.



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# INTERNATIONAL SEARCH REPORT

International Application No

PCT/EP 92/02344

<b>I. CLASSIFICATION OF SUBJECT MATTER</b> (if several classification symbols apply, indicate all) <sup>6</sup>		
According to International Patent Classification (IPC) or to both National Classification and IPC Int.Cl. 5 F25D19/00; F25D17/06		
<b>II. FIELDS SEARCHED</b>		
Minimum Documentation Searched <sup>7</sup>		
Classification System	Classification Symbols	
Int.Cl. 5	F25D ; F24F	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched <sup>8</sup>		
<b>III. DOCUMENTS CONSIDERED TO BE RELEVANT<sup>9</sup></b>		
Category <sup>10</sup>	Citation of Document, <sup>11</sup> with indication, where appropriate, of the relevant passages <sup>12</sup>	Relevant to Claim No. <sup>13</sup>
Y	US,A,4 920 764 (MARTIN) 1 May 1990	1
A	see column 5, line 61 - column 10, line 42; figures 2-13 ---	2-4,7
Y	US,A,3 313 122 (LAING) 11 April 1967	1
A	see column 3, line 31 - column 4, line 17; figures 1-2 ---	6
A	US,A,4 776 182 (GIDSEG) 11 October 1988	1-4,7
	see column 2, line 41 - column 7, line 48; figures 1-3,6,7 ---	
A	US,A,2 525 869 (CORHANIDIS) 17 October 1950	1-4,9
	see column 2, line 38 - column 4, line 6; figures 1-4 ---	
	-/--	
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Date of the Actual Completion of the International Search  19 FEBRUARY 1993		Date of Mailing of this International Search Report  26. 02. 93
International Searching Authority  EUROPEAN PATENT OFFICE		Signature of Authorized Officer  BOETS A.F.J.



III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)		
Category °	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
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A	US,A,2 660 867 (BORGERD) 1 December 1953 see column 2, line 51 - column 5, line 69; figure 1 ---	1,2,4,8, 9
A	DE,A,2 442 154 (KÜHLHAUS UND KÄLTETECHNIK GROSSKOPF) 11 March 1976 see page 6, paragraph 4 - page 10, paragraph 1; figure 2 ---	1,5,9
A	US,A,2 185 754 (RODMAN) 2 January 1940 ---	
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# ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO.

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US-A-3313122		None	
US-A-4776182	11-10-88	CA-A- 1293618	31-12-91
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US-A-2185754		None	
GB-A-992399		None	
US-A-3065553		None	
FR-A-1488737		None	

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